

REMARKS

Reconsideration and allowance of this Application are respectfully requested.

Upon entry of the foregoing amendment, claims 1 and 4-6 are pending in the application. Claim 1 has been amended to clarify the subject matter of the present invention. Support for the amendment to claim 1 is found, for example, on page 3, lines 18-23 of the specification. These changes introduce no new matter, and their entry is respectfully requested.

The Examiner has raised an issue of whether Applicants alleged repeated use of the terms “conventional art” and “background art” is admitted prior art. Applicants assert that the term “convention art” was used twice within the Specification on page 1 at lines 14 and 17. The term “background-art” was used once on page 2 of the Specification at line 13. Applicants’ use of these terms was merely for the purpose of describing Applicants’ in-house technology. Applicants submit herewith an affidavit under 37 C.F.R. §1.132 as evidence of this intended use.

The Office Action rejected claims 1 and 4-6 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. Applicants have amended claim 1 to clarify “the thickness” in line 7 to be the thickness “of said n-type clad layer.” With regard to line 8 of claim 1 which recites “said n-type clad layer is formed of a material substantially the same as said barrier layers”, Applicants direct the Examiner’s attention to page 5, line 17 – page 6, line 1 of the Specification to provide clarity that the n-type clad layer and the barrier layer are composed of the same material, but may be doped differently. Reconsideration and withdrawal of the rejection of claims 1 and 4-6 are requested.

The Office Action rejected claims 1 and 4-6 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 6,153,010, issued to Kiyoku *et al.* (“Kiyoku”) and U.S. Patent 5,959,307, issued to Nakamura *et al.* (“Nakamura”). Applicants traverse the rejections below because Kiyoku and Nakamura fail to disclose each element of the claimed invention. In particular, Kiyoku fails to teach a group III nitride compound semiconductor light-emitting device in which the n-type clad layer is in contact with the light-emitting layer, as recited in claim 1; and Nakamura fails to teach or suggest a single n-type clad layer having a specified thickness in a range of 100 Å to 500 Å, as recited in claim 1.

Kiyoku discloses a method of growing a nitride semiconductor crystal which has very few crystal defects and can be used as a substrate (Abstract). The Examiner has stated that Kiyoku discloses an active layer 215 “sandwiched between light guide (or clad) regions 214/216”. However, Applicants disagree with the assertion that light guide layer 214 is equivalent to the n-type clad layer of the present invention.

The n-side light guide layer 214 of Kiyoku is formed on the n-side cladding layer 213 and serves as a guide layer for light from the active layer 215 (Col. 22, lines 15-18). As such, the n-side light guide layer 214 is positioned between the n-side cladding layer 213 and the active layer/ multi-quantum well structure 215 (See Kiyoku, Fig. 10). Whereas, the n-type clad layer 15 of the present invention is in direct contact with the multi-layer quantum well structure 16, as illustrated in Figure 1 and recited in claim 1. Thus, the n-side cladding layer of Kiyoku is not in contact with the active light-emitting layer 215, as recited in claim 1 of the present invention, and Kiyoku fails to anticipate all the claimed features of the present invention.

Applicants note that the disclosed positioning of the layers in the present invention is necessary to confine the carrier in the light-emitting layer against the high carrier density n+

layer 13, while maintaining the color purity of the device. Further, n-type clad layer 15 of the present invention, which is in contact with the light emitting layer 16, is made thicker than each of the barrier layers 162 such that the thickness of the n-type clad layer is in a range of 100 Å to 500 Å. If the thickness of the n-type clad layer were made less than 100 Å, then it would be difficult to securely confine carriers in the light-emitting layer because the thickness would be too small. If the thickness of the n-type clad layer were made greater than 500 Å, then the color purity of the device would worsen.

Nakamura discloses a nitride semiconductor device having a nitride semiconductor layer structure that includes an active layer of a quantum well structure. As illustrated in Figures 3 and 5, the Nakamura device uses a combination of three n-clad layers 201, 202, 203, each having a different band energy gap. This combination of three n-clad layers permits a tunneling effect to develop in which the electrons or holes, i.e. carriers, are effectively injected from the 3rd layer into the active layer (Col. 4, lines 38-47).

In contrast to Nakamura, the n-type clad layer of the present invention consists of a single layer 15 having a thickness in a specified range of 100 Å to 500 Å to enhance the confining effect of the carriers. Thus, Nakamura fails to teach a single n-type clad layer having a thickness in a range as recited in claim 1. As such, Nakamura fails to anticipate claim 1.

Claims 4-6 depend from claim 1. Applicants have discussed above how independent claim 1 is distinguished and allowable over Kiyoku and Nakamura. By virtue of their dependency on claim 1, rejected claims 4-6 also include this subject matter. As such, dependent claims 4-6 are allowable for at least the same reasons as independent claim 1. Reconsideration and withdrawal of the rejection of claims 1 and 4-6 are respectfully requested.

The Office Action rejected claims 1 and 4-6 under 35 U.S.C. § 103(a) as being unpatentable over Applicants' alleged admitted prior art, and further in view of Nakamura. Applicants traverse the rejection because the subject matter depicted in Applicants' Figure 2 is improper prior art against the present application. Further Applicants traverse the rejection because Nakamura, analyzed alone, fails to teach or suggest all the combined features recited in the claims of the present application.

As stated above, Applicants submit herewith an Affidavit under 37 C.F.R. §1.132 to provide evidence of Applicants' intended use and description of the subject matter of Figure 2. Based upon this Affidavit, Applicants assert that Figure 2 is not prior art under §102.

The Office Action states that it would have been obvious to one of ordinary skill in the art to increase the thickness of the conventional n-clad layer illustrated in Applicants' Figure 2 for the purpose of increasing carrier confinement in the active region as taught by Nakamura. Applicants disagree.

In the Nakamura disclosure, a thin, n-clad layer is formed by a combination of three clad layers 201, 202, and 203. Each of clad layers 201, 202, and 203 has a different energy gap which helps to create a tunnel effect. Based upon the configuration of the n-clad layer, carriers may easily flow into as well as be confined in the active layer 16.

In contrast to the Nakamura disclosure, the n-type clad layer of the present invention has one layer having a thickness of a specific range, which permits the confinement of carriers without having to rely upon plural, n-clad layers.

Further, it is preferable that the first layer of the Nakamura device has a thickness sufficiently thin so that the electrons can pass through due to a tunneling effect (Col. 4, lines 42-45). Applicants submit that if the thickness of the clad layers 201, 202 and 203 of Nakamura were hypothetically in the larger range specified in claim 1, the tunneling effect

would be not be achieved and the intent of the Nakamura would be destroyed. Thus, the Nakamura disclosure would fail to provide proper motivation to one of ordinary skill to provide all the features of the present invention.

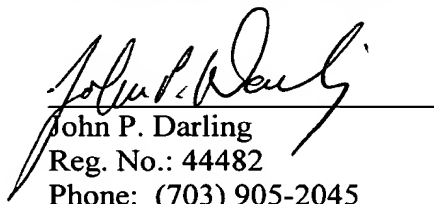
Based upon the above, Nakamura, analyzed alone, fails to teach or suggest all the combined features of the present invention as recited in claims 1 and 4-6. Accordingly, Applicants respectfully request reconsideration and withdrawal of the §103 rejection.

All of the stated grounds of rejection have been properly traversed. In view of the foregoing, the claims and specification are in form for allowance, and such action is hereby solicited. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is requested to call the undersigned at the number provided.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached Appendix is captioned “Version with markings to show changes made”.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please amend the following claim:

1. (Twice Amended) A group III nitride compound semiconductor light-emitting device comprising:

a light-emitting layer of a multilayer quantum well structure composed of alternately laminated well layers and barrier layers; and

an n-type clad layer being in contact with said light-emitting layer,

wherein said [n-layer] n-type clad layer is made thicker than each of said barrier [layer] layers and the thickness of said n-type clad layer is in a range of 100 Å to 500 Å, wherein said [n-clad] n-type clad layer is formed of a material substantially the same as said barrier layers.